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Caldara et al.

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## [54] ALLOCATED AND DYNAMIC BANDWIDTH MANAGEMENT

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[58] Field of Search 370/250, 252, 370/253, 351, 389, 391, 392, 395, 398, 399, 412, 413, 414, 428, 429, 465, 468, 230, 235; 340/825.15

## [56] References Cited

## U.S. PATENT DOCUMENTS

3,804,991	4/1974	Hammond et al.	379/222
4,069,399	1/1978	Barrett et al.	370/363
4,715,030	12/1987	Koch et al.	370/401
4,727,537	2/1988	Nichols	370/236
4,737,953	4/1988	Koch et al.	370/401
4,797,881	1/1989	Ben-Artzi	370/402
4,837,761	6/1989	Isono et al.	370/413
4,849,968	7/1989	Turner	370/232
4,870,641	9/1989	Pattavina	370/397
4,872,159	10/1989	Hemmady et al.	370/352
4,872,160	10/1989	Hemmady et al.	370/352
4,878,216	10/1989	Yunoki	370/389
4,893,302	1/1990	Hemmady et al.	370/427
4,893,307	1/1990	McKay et al.	370/389
4,894,824	1/1990	Hemmady et al.	370/380
4,897,841	1/1990	Gang, Jr.	370/401

4,899,333 2/1990 Roediger ..... 370/427  
 4,920,531 4/1990 Isono et al. ..... 370/416  
 4,922,503 5/1990 Leone ..... 370/402

(List continued on next page.)

## OTHER PUBLICATIONS

*Head of Line Arbitration in ATM Switches With Input-Output Buffering and Backpressure Control.* By Hosein F. Badran and H. T. Moutah, Globecom '91, pp. 0347-0351. An Ascom Timeplex White Paper. *Meeting Critical Requirements with Scalable Enterprise Networking Solutions Based on a Unified ATM Foundation*, pp. 1-12, Apr. 1994-Apr. 1995.

Douglas H. Hunt, *ATM Traffic Management—Another Perspective*, Business Communications Review, Jul. 1994.

(List continued on next page.)

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## [57] ABSTRACT

An ATM network switch and method of utilization for adaptively providing integrated services therein is disclosed. In providing such integrated services, if the allocated bandwidth for one connection has been consumed, or if the connection is not entitled to allocated bandwidth, the connection can optionally use dynamic bandwidth arbitration, or a combination of both allocated and dynamic. The switch includes an input port processor, a bandwidth arbiter, and an output port processor. Cells are transmitted from the input to the output, under the control of respective port processors and the bandwidth arbiter. Flow control is implemented on a per-connection basis. Individual queues are then assigned to traffic type groups in order to provide traffic type flow control. Based upon prioritization information associated with the cell at the input, cells are prioritized and transmitted from the output, with each cell maintained in the same order, relative to other cells on a connection, in which it was received.

51 Claims, 10 Drawing Sheets

